



Worksheet 3 Karnaugh maps

Task 1

1. Fill in Karnaugh maps for the following expressions, showing the groupings by ringing them.

In parts (d), (e) and (f), fill in the missing row and column labels.

(a) A

(b) $\neg A \wedge C$

BC^A

	00	01	11	10
0				
1				

	00	01	11	10
0				
1				

(c) $A \wedge \neg B$

(d) B

(e) $A \wedge B \wedge \neg C$

BC^A

0				
1				

0				
1				

2. Fill in Karnaugh maps for the following expressions, showing the groupings. Hence simplify the expressions.

(a) $(A \wedge B) \vee (A \wedge \neg C) \vee (A \wedge \neg B)$

(b) $(A \wedge B \wedge C) \vee (\neg A \wedge B) \vee (A \wedge B \wedge \neg C)$

BC^A

	00	01	11	10
0				
1				

	00	01	11	10
0				
1				

3. Use a Karnaugh map to show that $A \vee \neg A \wedge B = A \vee B$.

(You drew a truth table to prove this in Worksheet 2, Question 4)

B^A

	0	1
0		
1		



Task 2

4. What Boolean expressions do each of the ringed squares in the Karnaugh map in Figure 1 represent?

AB
CD

	00	01	11	10
00			1	
01				
11				
10			1	

Figure 1

Row 1 column 3 =

Row 4 column 3 =

Write the Boolean expression represented by the map in its simplest form.

5. (a) Ring the two groups in Figure 2. What Boolean expression does this Karnaugh map represent?

AB
CD

	00	01	11	10
00			1	
01				
11		1	1	
10			1	

Figure 2



(b) Complete the Karnaugh map in Figure 3 to represent the expression:

$$(A \wedge B \wedge C \wedge \neg D) \vee (\neg A \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the resulting group(s) and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 3

(c) Complete the Karnaugh map in Figure 4 to represent the expression:

$$(A \wedge B \wedge C) \vee (C \wedge D) \vee (A \wedge \neg C) \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the groups, and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 4



(d) Complete the Karnaugh map in Figure 5 to represent the expression:

$$(\neg A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (\neg A \wedge \neg B \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the group(s), and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 5

(e) Complete the Karnaugh map in Figure 6 to represent the expression:

$$(\neg A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (\neg A \wedge \neg B \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (A \wedge \neg B \wedge C \wedge \neg D) \vee (\neg B \wedge D)$$

Draw the group(s), and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 6

7. How many squares in a Karnaugh map with 4 variables contain 1 when an expression containing only AND symbols has:
- 4 variables, e.g. $(\neg A \wedge \neg B \wedge \neg C \wedge \neg D)$?
 - 3 variables e.g. $(A \wedge B \wedge C)$?
 - 2 variables, e.g. $(\neg B \wedge D)$?
 - 1 variable, e.g. A ?